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Industrial automation systems and integration –
Integration of life-cycle data for oil and gas production facilities –
Part 1: Overview and fundamental principles

ABSTRACT:

This document provides an overview of ISO 15926 "Integration of life-cycle data for oil and gas production facilities"

KEYWORDS:

industrial data, oil and gas, facility, life-cycle, integration, overview

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Comments to reader:

This is a second draft of ISO 15926-1 for review by members of WG3 T21 "Oil and gas; a workshop to resolve issues against Parts 1 and 2 of ISO 15926 will be held in Oslo from 1999-03-23/25

Interim editorial guidelines, and an accompanying Word template, have been used in the preparation of this document. These guidelines apply the requirements of the ISO/IEC Directives 3, and appropriate requirements of the SC4 Supplementary Directives for ISO 10303. Editorial notes and issues within the text are indicated through the use of boxed text.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

We are still awaiting clarification from the ISO Central Secretariat with respect to the inclusion/exclusion of the paragraph above.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 15926-1 was prepared by Technical Committee ISO/TC184, *Industrial automation systems and integration*, Subcommittee SC4, *Industrial data*.

ISO 15926 consists of the following parts under the general title *Industrial automation systems and integration – Integration of life-cycle data for oil and gas production facilities*:

— Part 1, Overview and fundamental principles;

— Part 2, Data model;

— Part 3, Methodology for the development and maintenance of reference data libraries;

— Part X, Reference data[1];

— Part Y, Conformance[2];

— Part Z, Procedures for registration and maintenance of reference data[1].

The structure of this International Standard is described in this part of ISO 15926.

Annexes A and B form an integral part of this part of ISO 15926.

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[1] Parts X and Z are being developed, as the initial content and procedural standard respectively, as components of a Reference Data Library supporting implementation and use of ISO 10303-221 as well as ISO 15926. The designation of these components (as parts of ISO 10303, ISO 15926, or some other standard) has not yet been determined.

[2] To be proposed as an additional Part of this International Standard.

0 Introduction

Numbering of the Introduction and of subsections within it (0.1, 0.2, etc. is permitted by the ISO/IEC Directives Part 3 but has not (to the best of my knowledge) been used previously within SC4. Input from the Quality Committee is required with respect to this.

0.1 Background

Information concerning the engineering, construction and operation of oil and gas production facilities is created, used and modified by many different organizations throughout a facility's life. Economic, safety and environmental considerations demand that this information is available to owners and operators of production facilities, contractors, and regulatory bodes in a consistent, integrated form. This requirement can be satisfied by specifications that prescribe the structure and meaning of data that is shared by organizations and disciplines involved in all stages of a facility's life-cycle.

The need to increase the cost efficiency of oil and gas facilities is leading to business practices that depend on the efficient integration and sharing of plant information in a computer processable form:

a) Many users' needs now span more than one of the traditional information views. Safety and environment are two examples of this.

b) Concurrent engineering requires design work to progress in parallel, with the state of the design being available electronically, in computer processable form, to other engineering, planning, purchasing and logistical activities.

c) Significant cost savings are expected from standardisation of component specifications. The information about these specifications is required in computer processable form for easy incorporation into facility designs and requirements.

d) In the past, hand-over of plant design information was often restricted to design drawings and paper documents. Use of this information in managing the operation and modification of the plant was restricted to manual processes, or the information had to be redefined in a format suitable to the required application. Having the plant design and equipment information in computer processable form increases the efficiency and effectiveness of the operational phase of the plant.

e) Accurate computer processable information about the plant performance throughout its lifetime is of high value, for optimising future modifications to the plant and for designing new plants on the basis of experience with existing plants.

By using a consistent context for data definitions, the information used in the various aspects of the plant life-cycle can be brought together. This allows information to be integrated, shared and exchanged in a consistent, computer processable form.

0.2 Purpose of ISO 15926

The purpose of this International Standard is to facilitate integration of data to support the lifecycle activities and processes of oil and gas production facilities. To do this, this International Standard specifies a data model that defines the meaning of the lifecycle information in a single context supporting all the views that process engineers, equipment engineers, operators, maintenance engineers and other specialists may have of the facility.

Traditionally, data associated with an oil and gas production facility have been concentrated on some individual view of the facility at a point in time. Such data are usually defined and maintained independently of other groups of users, resulting in duplicated and conflicting data that cannot be shared either within an enterprise or with business partners of an enterprise.

0.3   Description of ISO 15926

ISO 15926 is an International Standard for the representation of oil and gas production facility life-cycle information. This representation is specified by a generic, conceptual data model that is suitable as the basis for implementation in a shared database or data warehouse. The data model is designed to be used in conjunction with reference data – standard instances that represent information common to a number of users, production facilities, or both.

ISO 15926 is organized as a number of parts, each published separately. This part of ISO 15926 provides an overview. It specifies the contents and functions of the different parts of ISO 15926 and the relationships between them, and describes:

a)   an overview of ISO 15926;

b)   the fundamental principles that are the basis of ISO 15926;

c)   the relationship of ISO 15926 to other industrial data standards;

d)   definitions of terms used throughout ISO 15926.

This part of ISO 15926 makes reference to parts 3, X and Z of this International Standard. These are – or are a contribution to – the technical standard, the initial content, and the procedural standard respectively of the Reference Data Library that supports ISO 10303-221 as well as ISO 15926. References here to these as parts of ISO 15926 does not assume that this will be their final designation: they could be parts of ISO 15926, ISO 10303, ISO 13584, or some other standard.

Industrial automation systems and integration – Integration of life-cycle data for oil and gas production facilities – Part 1: Overview and fundamental principles

1 Scope

This International Standard provides a representation of information associated with engineering, construction and operation of oil and gas production facilities. This representation supports:

a) the information requirements of the oil and gas industries in all phases of a facility's life-cycle;

b) sharing and integration of information amongst all parties involved in the facility's life cycle.

The following are within the scope of ISO 15926:

a) a generic, conceptual data model that supports representation of all life-cycle aspects of an oil and gas production facility;

b) a reference data library that represents information common to many oil and gas production facilities and users;

c) rules for developing and validating the content of reference data libraries;

d) conformance to the requirements of this International Standard;

e) procedures for registering and maintaining reference data libraries .

The scope of business activities that are supported by the International Standard is illustrated in Figure 1[3], which shows the main activities and data flows associated with the lifecycle of a facility.

> It is intended that the updated "PIEBASE" activity model will be substituted for the version shown here, as and when the former is available in an equivalent ("bright colours") form.

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[3] This Figure is based on the Process Plant Engineering Activity Model [3].

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┌──────────────┐   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
│   Produce    │   │   Produce    │   │  Commission  │   │   Operate    │   │ Decommission │
│  Conceptual  │──▶│   Detailed   │──▶│    Plant     │──▶│    Plant     │──▶│    Plant     │
│Process Design│   │Process Design│   │              │   │              │   │              │
└──────────────┘   └──────────────┘   └──────────────┘   └──────────────┘   └──────────────┘
        │                  │                  ▲                  ▲                  │
        ▼                  ▼                  │                  ▼                  ▼
┌──────────────┐   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
│   Produce    │   │              │   │ Construct    │   │Maintain Plant│   │Demolish Plant│
│  Conceptual  │   │   Produce    │──▶│   Plant      │──▶│     and      │   │and Restore   │
│Engineering   │──▶│   Detailed   │   │Pre-Commission│   │  Equipment   │   │    Site      │
│Design(Front  │   │  Engineering │   │              │   │              │   │              │
│    End)      │   │   Design     │   │              │   │              │   │              │
└──────────────┘   └──────────────┘   └──────────────┘   └──────────────┘   └──────────────┘
                          │                  │                  ▲
                          ▼                  ▼                  │
┌──────────────┐   ┌──────────────────────────────────────────────────────┐
│ Suppliers and│──▶│ Procure and Control Equipment, Material and Services   │
│  Fabricators │◀──│                                                        │
└──────────────┘   └──────────────────────────────────────────────────────┘
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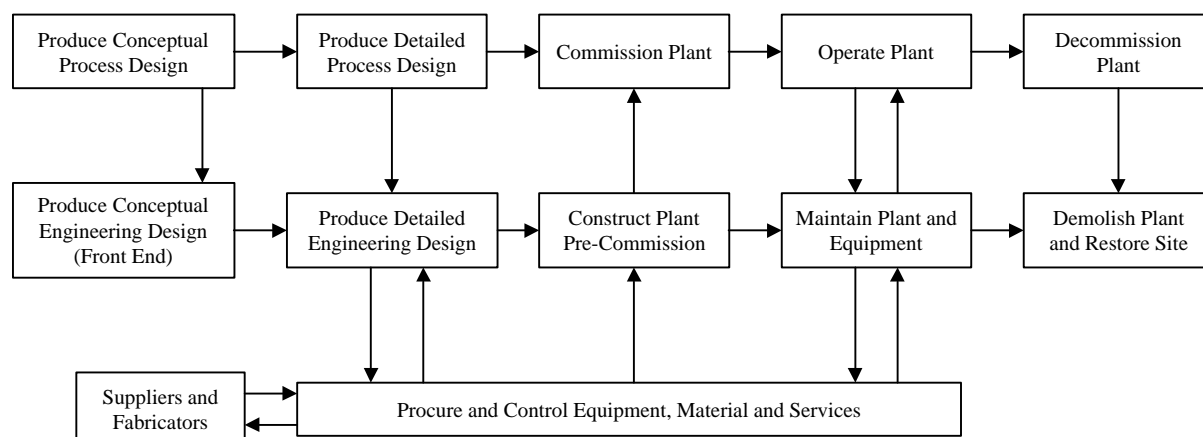
Figure 1 - Oil and gas production life-cycle activities

NOTE 1   The support for a specific life-cycle activity depends on the use of appropriate reference data in conjunction with the data model defined in ISO 15926-2.

EXAMPLE   A reference data library covering technical data about process systems, electrical systems and instrumentation systems can support design, engineering and maintenance activities for these systems within an oil and gas production facility.

The following are outside the scope of ISO 15926:

a)   commercial, business, and administrative data that is not directly related to the engineering, operation and maintenance of oil and gas production facilities;

b)   specification of interfaces or transformations that provide particular external views or input/output capabilities with respect to facility life-cycle data.

This International Standard is applicable to implementation of databases or data warehouses that enable integration and sharing of data amongst different participants in the life cycle of an oil and gas production facility. The generic data model specified in ISO 15926-2 provides a suitable conceptual model for such a database or data warehouse.

NOTE 2   See 5.2 for further information concerning the nature of conceptual data models.

This part of ISO 15926 provides an overview of this International Standard. The scopes of the other parts of ISO 15926 are defined within those parts.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/IEC 8824-1:1994, *Information technology – Open systems interconnection – Abstract syntax notation one (ASN.1) – Part 1: Specification of basic notation.*

ISO 10303-1:1994, *Industrial automation systems and integration – Product data representation and exchange – Part 1: Overview and fundamental principles.*

3 Terms, definitions, and abbreviations

For the purposes of this International Standard, the following terms, definitions and abbreviations apply; those taken or adapted from ISO 10303-1 are repeated below for convenience.

NOTE   Definitions copied verbatim from ISO 10303-1 are followed by "[ISO 10303-1]". Definitions that have been adapted from ISO 10303-1 are followed by "[Adapted from ISO 10303-1]".

This list is not yet complete. A detailed review of terminology is needed to ensure that all necessary terms that are used in more than one part of ISO 15926 are given here.

3.1
ANSI/SPARC
American National Standards Institute/Standards Planning and Research Committee

3.2
application protocol
AP
a part of (ISO 10303) that specifies an application interpreted model satisfying the scope and information requirements for a specific application.

[adapted from ISO 10303-1]

3.3
data
a representation of information in a formal manner suitable for communication, interpretation, or processing by human beings or computers.

[ISO 10303-1]

3.4
data warehouse
a data store in which related data are merged to provide an integrated set of data conatining no duplication or redundancy of information, and which supports many different application viewpoints.

3.5
distinct facility data
facility life-cycle data that represents information that is distinct to a particular oil and gas production facility.

3.6
facility life-cycle data
data that represents, in computer processable form, information about one or more oil and gas production facilities.

3.7
information
facts, concepts, or instructions.

[ISO 10303-1]

3.8
instance
data that represents, in computer processable form, some real world thing.

3.9
reference data library
a managed collection of reference data.

3.10
reference data
facility life-cycle data that represents oil and gas production facilities. The complement of distinct facility data for data of a particular facility.

4 Overview of ISO 15926

ISO 15926 is divided into a number of parts. Each part has a unique function.

ISO 15926-1 (this part) provides an overview of ISO 15926.

ISO 15926-2 specifies a generic, conceptual data model that supports representation of all life-cycle aspects of an oil and gas production facility.

ISO 15926-3 specifies methods for developing and validating reference data libraries.

The following will be added when Parts X, Y and Z are proposed as additional components of the standard:

ISO 15926-X specifies a reference data library that represents information common to many oil and gas production facilities and users.

ISO 15926-Y specifies the criteria to be used in assessing conformance to the requirements of this International Standard.

ISO 15926-Z specifies the procedures to be followed for registration and maintenance of reference data

These will be added only for those parts that will be published as ISO 15926; parts 3, X and Z are all candidates for inclusion in a separate standard supporting the common RDL for ISO 10303-221 and ISO 15926.

5 Fundamental principles

5.1 Architecture

The architecture that underlies this International Standard is illustrated in Figure 2. The data that describes a particular facility is structured according to the generic data model. Consistency of meaning within the distinct

facility data, and across multiple sets of distinct facility data, is provided through reference to shared, standard instances of the data model (reference data).

The data model supports representation of both classes and class members as entity instance data with attribute value data. Characteristics common to the class members are defined once as computer processable data. Characteristics of particular items are then specified by reference to the appropriate classes.

EXAMPLE   A particular pipe may be identified as a member of the class "6 inch pipe", thereby specifying the particular pipe's dimensions to be within the range of possible dimensions specified for the class.

Information about particular items that conform, or are intended to conform, to standards or to standardized engineering practices is represented in a concise and accurate form, without duplication. The detailed classes that have been recognised in the information associated with oil and gas facilities are defined as reference data which form part of this specification for representing lifecycle information.

NOTE   A core reference data library is specified in ISO 15926-X. Rules for developing and validating additional reference data libraries are specified in ISO 15926-3. Procedures for maintaining reference data libraries are specified in ISO 15926-Z.

This NOTE assumes that parts X and Z are to be added to ISO 15926, or that parts 3, X and Z are published as a separate standard defining and supporting the common reference data library with ISO 10303-221.
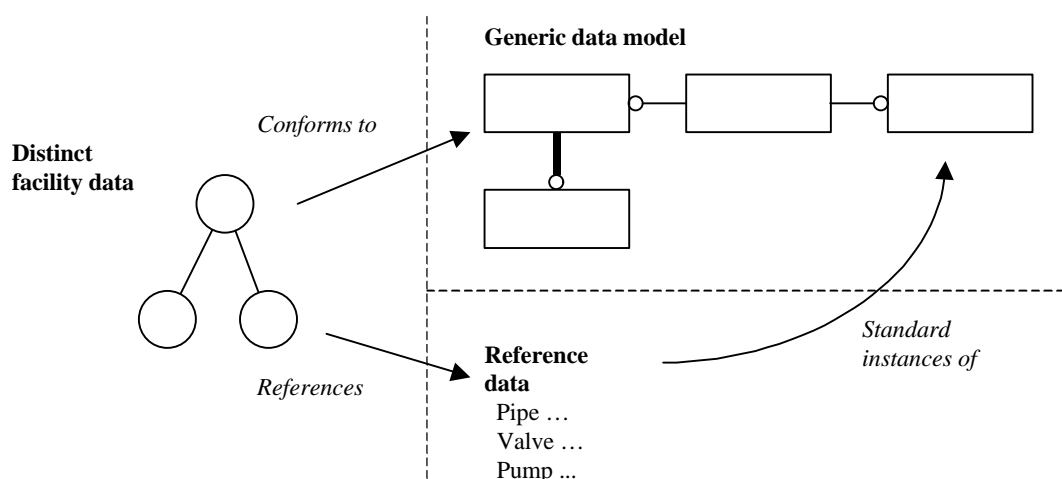

Figure 2 - Architecture

5.2   Conceptual models

The data model specified in ISO 15926-2 is a conceptual model as described in the ANSI/SPARC architecture. The model excludes all business rules that are appropriate to specific applications, to enable integration of information and to give a stable and flexible model with respect to developing and changing business practices.

The ANSI/SPARC three-level architecture identifies three types of data model:

a)   External model: the data structure corresponds to a view of data for a particular purpose that includes rules about the data that are appropriate to the particular purpose.

b)   Conceptual model: a neutral model that is capable of supporting any valid view that falls within its scope. Such models can only include rules for data that are universally true across its entire scope for the envisaged life of the model. As a consequence most rules or constraints arising from particular business uses of data are excluded from conceptual models.

c)   Physical model: a definition of the way data is stored. The entity types reflect things that are important for storage and access and not the business meaning of the data.

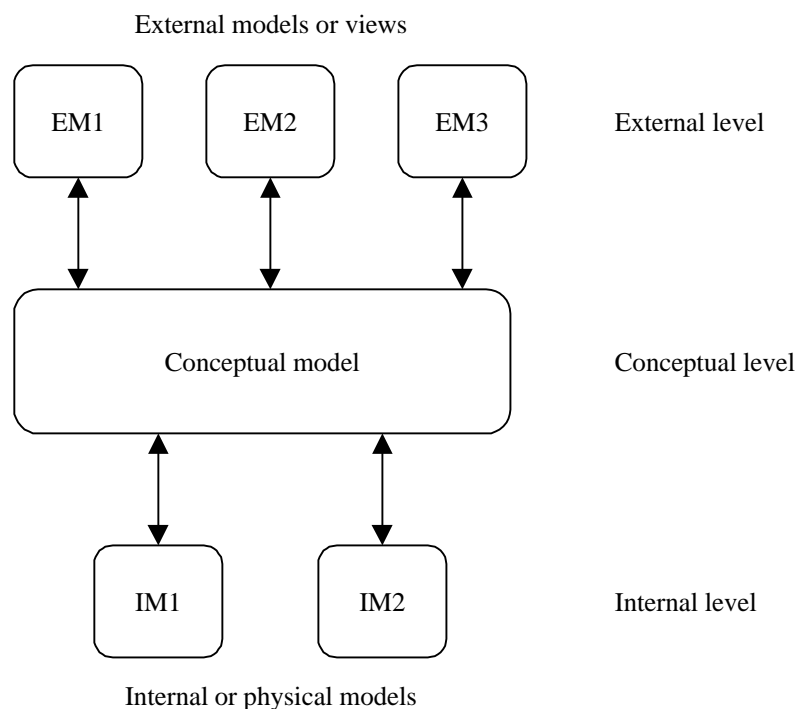These concepts are illustrated in Figure 3.

External models or views

```
  ┌──────┐      ┌──────┐      ┌──────┐
  │ EM1  │      │ EM2  │      │ EM3  │       External level
  └──────┘      └──────┘      └──────┘
     ↕             ↕             ↕
  ┌────────────────────────────────────┐
  │                                    │
  │          Conceptual model          │     Conceptual level
  │                                    │
  └────────────────────────────────────┘
         ↕                  ↕
     ┌──────┐           ┌──────┐
     │ IM1  │           │ IM2  │            Internal level
     └──────┘           └──────┘
```

Internal or physical models

Figure 3 - ANSI/SPARC three-level architecture

5.3   Conformance

A conforming implementation of this International Standard is a database, data warehouse, or other information system that supports storage, management, and manipulation of data according to the model specified in ISO 15926-2. A conforming implementation of this International Standard shall include the reference data specified in ISO 15926-X. A conforming implementation shall support an external view that is structurally and semantically equivalent to the conceptual model

NOTE   ISO 15926-2 specifies a conceptual model; therefore this International Standard does not prescribe the structures that exist within a database or other implementation.

5.4   Registration and maintenance of reference data

As described in 5.1 implementation and use of this International Standard requires both a conceptual data model and reference data. The conceptual data model is specified in ISO 15926-2. The reference data library that is specified in ISO 15926-X does not include all reference data that is required for all implementations of this international standard. Data elements can be added, removed or updated and new revisions of the reference data library published, as shown in Figure 4 below.
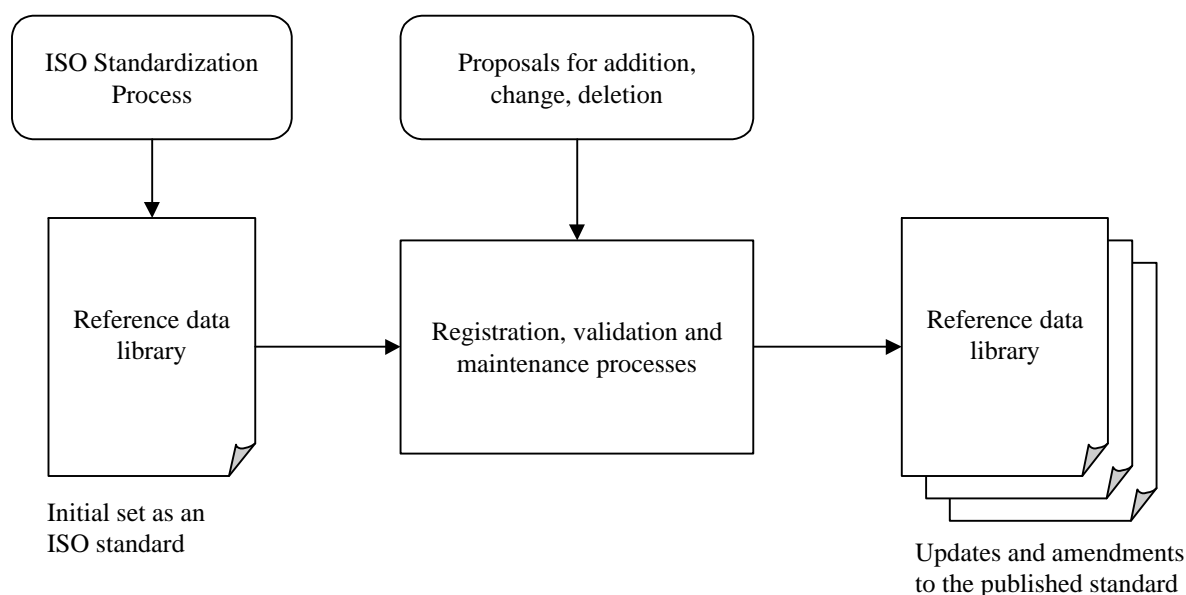
Figure 4 – Maintenance of reference data

The initial content of the reference data library is specified in ISO 15926-X. The technical standard for the validation of reference data is specified in ISO 15926-3. The procedural standard for registration and maintenance of reference data is specified in ISO 15926-Z.

Parts 3, X and Z will be redesignated if the reference data library is the subject of a different ISO standard.

6 Relationship to other industrial data standards

ISO 15926 can be used in conjunction with other standards for industrial data. Such standards fall into two categories:

— standards that specify the representation of industrial information within computer systems and communications between computer systems, and

— standards that specify data elements and their meanings, independent of particular representation.

NOTE   These categories are not mutually exclusive. Standards such as ISO 10303 Application Protocols specify the representation of data and its meaning.

6.1   Industrial data representation standards

ISO 15926 is complementary to a number of other standards for the representation of industrial data.

6.1.1   ISO 10303 "Product data representation and exchange"

This International Standard makes use of ISO 10303-11 "EXPRESS" for specification of data models. Implementations of this International Standard may be based on any implementation form that has a mapping from EXPRESS.

EXAMPLE 1   Suitable implementation forms include ISO 10303-21, ISO 10303-22, and the Data Access and Exchange Facilities (DAEF) developed by the Petrotechnical Open Software Corporation (POSC).

This International Standard supports representation of life-cycle data for oil and gas production facilities in a form that is suitable for implementation in a shared database or data warehouse. ISO 10303 Application Protocols provide specifications for the exchange of well-defined subsets of the total life-cycle data. ISO 10303 Application Protocols may therefore be used to specify standard interfaces for the input or output of data stored in a database or data warehouse.

EXAMPLE 2   ISO 10303-231 specifies how process design information for major equipment items can be exchanged. An interface conforming to ISO 10303-231 may be used to import or export equipment design data that is stored within a database that is based on the data model specified in ISO 15926-2.

NOTE   This International Standard does not specify such interfaces or transformations.

6.1.2   ISO 13584 "Parts library"

ISO 13584 provides a mechanism for representing manufacturers' and suppliers' product catalogue information. This mechanism is suitable for communication of catalogue information, and for the selection of parts based on a standard query interface specification. This mechanism provides an alternative representation for some of the information that can be represented using the data model specified in ISO 15926-2 and the reference data library specified in ISO 15926-X.

NOTE 1   ISO 13584 does not support all aspects of oil and gas facilities information, and so precludes creation and maintenance of a single integrated data representation of this information.

Parts library information represented by ISO 13584 data can be transformed to a representation that conforms to the data model specifed in ISO 15926-2.

NOTE 2   The specification of such transformations are outside the scope of this International Standard.

> I'm not sure that a stronger statement than this is possible with respect to PLIB. There may be a requirement for a study to validate/refute this statement.

6.2   Product and manufacturing standards

Many products, processes and materials are the subject of standards that prescribe aspects such as form, function, properties, or manufacture. Many of these standards are published as text only, and are therefore not computer processable. The information that these standards contains, however, may be represented using reference data that conforms to this International Standard. This provides a mechanism by which consistent repre-

sentation of engineering information drawn from diverse international and national standards may be brought together for use in an enterprise or project.

NOTE 1   ISO 15926-X specifies a core reference data library that includes references to product and manufacturing standards.

NOTE 2   ISO 15926-3 describes rules for representing information in product and manufacturing standards as ISO 15926 compliant reference data.

Annex A
(normative)

Information object registration method

In order to provide unambiguous identification of schemas and other information objects in an open information system, this International Standard employs the registration technique defined in ISO/IEC 8824-1.

NOTE   This registration technique is equivalent to that defined in 4.3 of ISO 10303-1 for information objects standardized in ISO 10303.

> It would be useful if 4.3 of ISO 10303-1 could be generalized so that it could be referenced from here, rather than repeated with minor changes. The description here also needs to be validated against the more detailed information provided in the latest draft of the SC4 Supplementary Directives.

This technique identifies objects by their assignment to a tree structure whose root is ISO itself. Each node in the tree is identified by a sequence of integers corresponding to the index of the leaf under each node. Nodes that identify agencies that can further specify inferior nodes are called registration authorities. There is provision in this technique for having registration provided by national bodies and other identified organizations (including private corporations). A registration authority is automatically granted to the technical committee or subcommittee that prepares a standard in order to identify objects within the standard.

Thus, ISO 15926 is identified by the object identifier:

$$\{ \ 1 \ 0 \ 15926 \ \}$$

Here the initial 1 indicates ISO; the 0 following it identifies the object as a standard, and the number following that is the number of the standard. ISO/IEC 8824-1 also defines identifiers to stand in the place of these numbers; thus 'iso' has the value 1 and 'standard' has the value 0. For multi-part standards, the next number is required to be the part number. Thus, this part of ISO 15926 is identified by the object identifier:

$$\{ \ iso \ standard \ 15926 \ part(1) \ \}$$

Here, the value of the part number is given explicitly, but the notation allows us to associate a term with this value, thereby providing some semantics. The notation for values of this type is defined in clause 28 of ISO/IEC 8824-1, and the predefined assignments are specified in annex B of ISO/IEC 8824-1.

For the purposes of identifying information objects unambiguously within an open information system, ISO 15926 adopts the following conventions:

a)   The value following the part number shall be version number. By convention, the value of the version number of the first edition shall be 1. The value 0, if used at all, is reserved to refer to DIS documents.

b)   The value following the version number is used to identify the type of information object defined within the part. The value 1 shall indicate that the object so identified is a schema.

c)   The value following the object type is an integer that identifies the instance of the object type so identified.

d)   To meet the syntactic requirements of ISO/IEC 8824-1, replace each occurrence of underscore character "_" in a schema name with a hyphen when defining this value.

EXAMPLE   The oil_and_gas_production_facilities schema defined in ISO 15926-2 can be identified by the value

```
{ iso standard 15926 part(2) version(1) object(1)
    oil_and_gas_production_facilities (1) }
```

Annex B
(normative)

Information object registration

To provide for unambiguous identification of an information object in an open system, the object identifier

{iso standard 15926 part{1} version {1}}

is assigned to this part of ISO 15926. The meaning of this value is defined in ISO/IEC 8824-1, and is described in Annex A.

This is the object identifier that will apply to the published (IS) version of this part of ISO 15926.

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